Experiment 5 Preliminary Work
Frequency Response

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May 15, 2022

Contents

1   Step 1

The document entitled "Notes on Frequency Response" is read.

2 Step 2

C1

R1

$v_i(t) = V_i \sin(\omega t)$

$v_o(t)$

+

−

$R_1 = 33 \text{ k}\Omega$

$C_1 = 0.01 \text{ μF}$
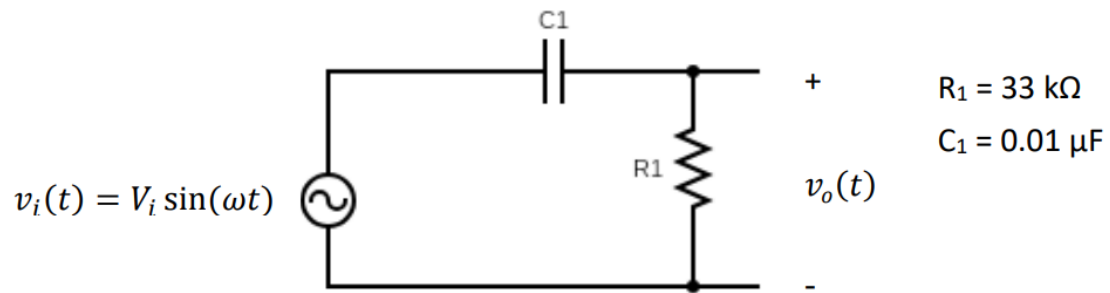
Figure 1: RC Filter circuit schematic for the step 2

3 Step 3

L1

C1

R1

R2

$v_i(t) = V_i \sin(\omega t)$

$v_{o1}(t)$

+

−

$v_{o2}(t)$

+

−

$R_1 = 2.7 \text{ k}\Omega$

$R_2 = 33 \text{ k}\Omega$

$C_1 = 0.01 \text{ μF}$

$L_1 = 0.1 \text{ H}$
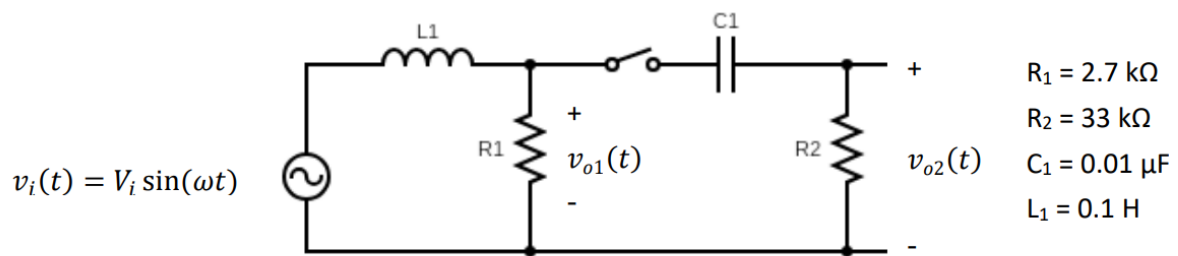
Figure 2: Low-Q RC Filter circuit schematic for the step 3

3.1 a.

3.2 b.

4 Step 4

$v_i(t) = V_i \sin(\omega t)$

R1

L1   C1 $v_o(t)$ +

$\omega_o = 10\ \text{krad/sec}$
$v_i(t) = V_i \sin(\omega t)$
$L_1 = 0.1\ \text{H}$
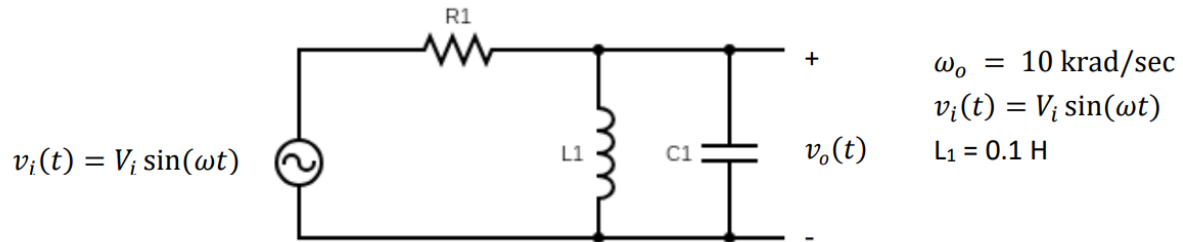
Figure 3: High-Q RC Filter circuit schematic for the step 4

4.1 a.

4.2 b.

4.3 c.

$v_i(t)$

V_i

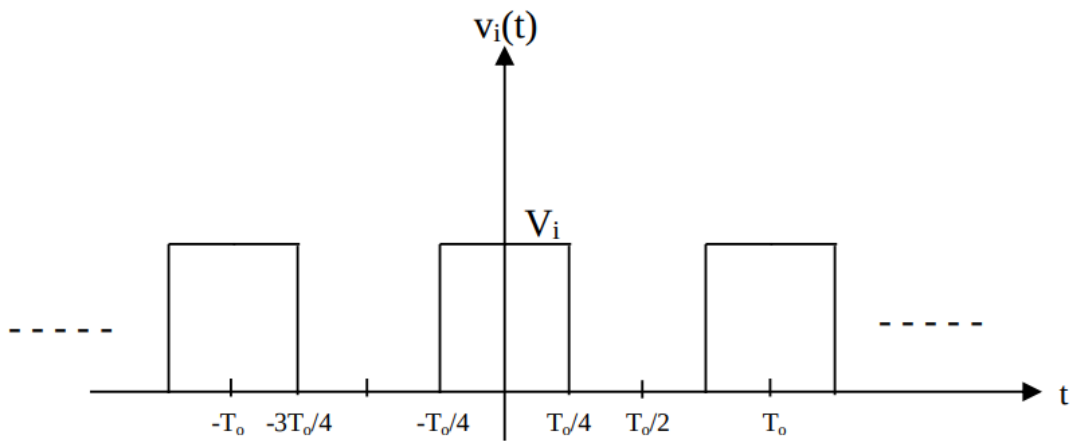$-T_o$ $-3T_o/4$ $-T_o/4$ $T_o/4$ $T_o/2$ T_o t

Figure 4: Input waveform

4.4   d.

5   Step 5

6   Step 6

In this step necessary simulations are made.

6.1   a.

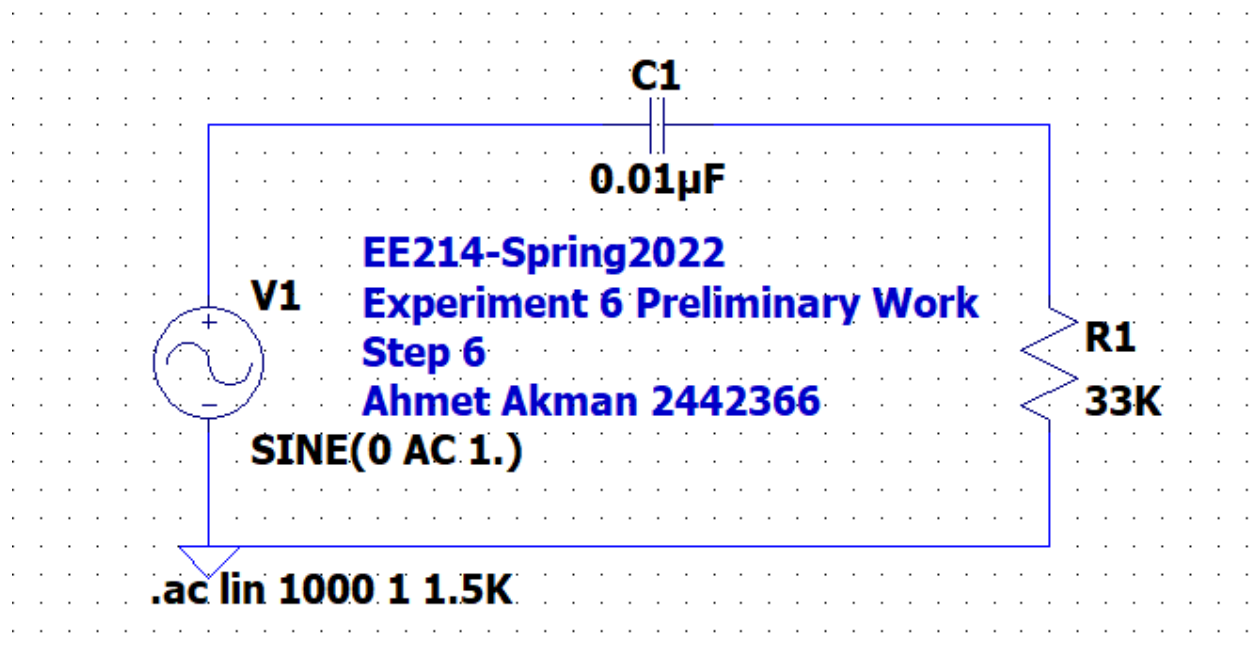The circuit given in Figure 1 is simulated in LTSpice simulation environment as given in Figure 5.

Figure 5: Simulation circuit schematic for the step 6 part a
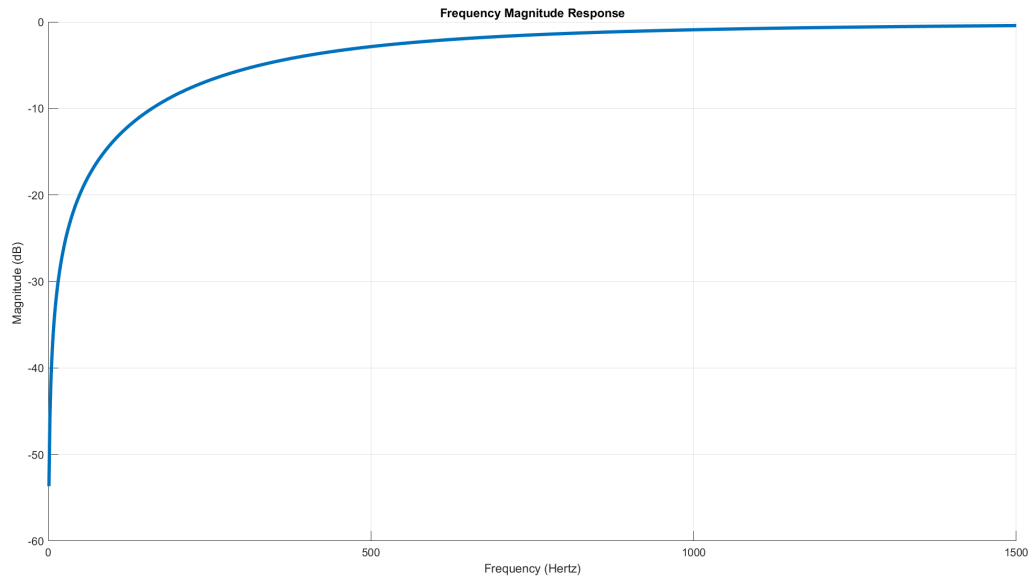
As a result the plot given in Figure 6 is obtained.

Figure 6: Frequency Response of a High Pass Filter

6.2   b.

The circuit given in Figure 2 is simulated in LTSpice simulation environment as given in Figure 7.
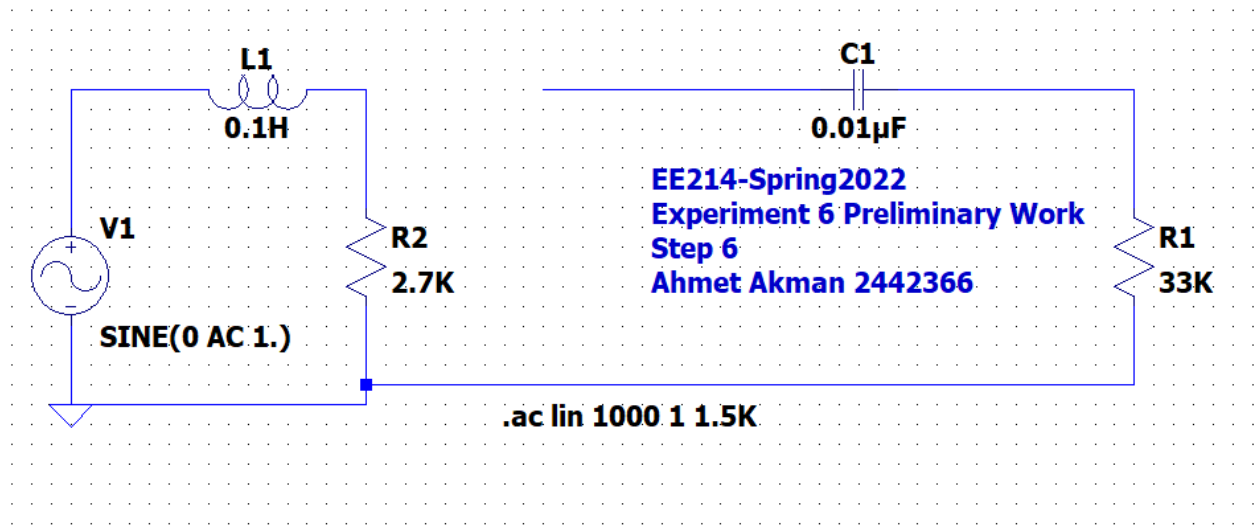

Figure 7: Simulation circuit schematic for the step 6 part b

6.2.1   i.

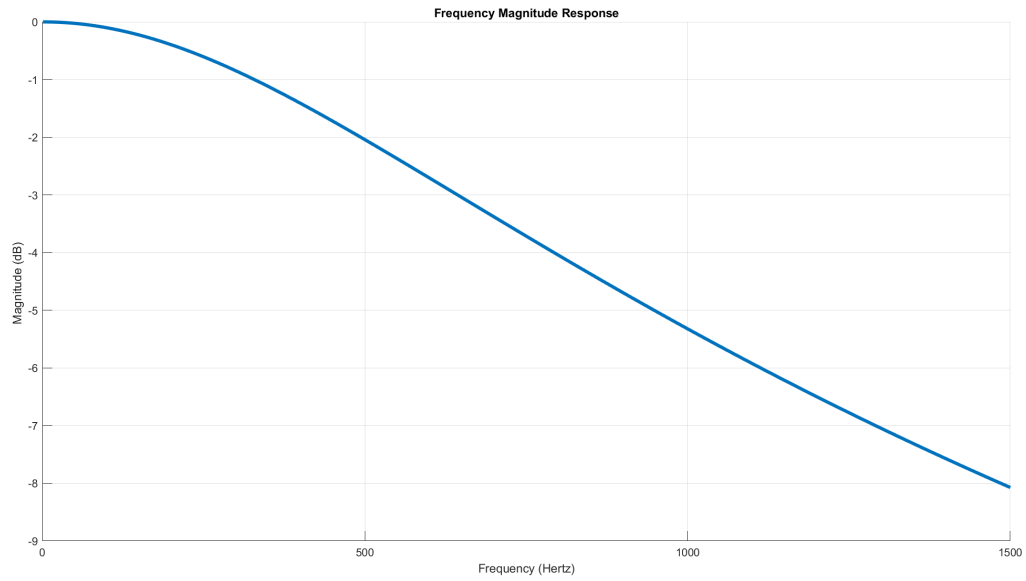As the switch opened the plot given in Figure 8 is obtained.

Figure 8: Frequency Response of a Low Pass Filter

6.2.2 ii.

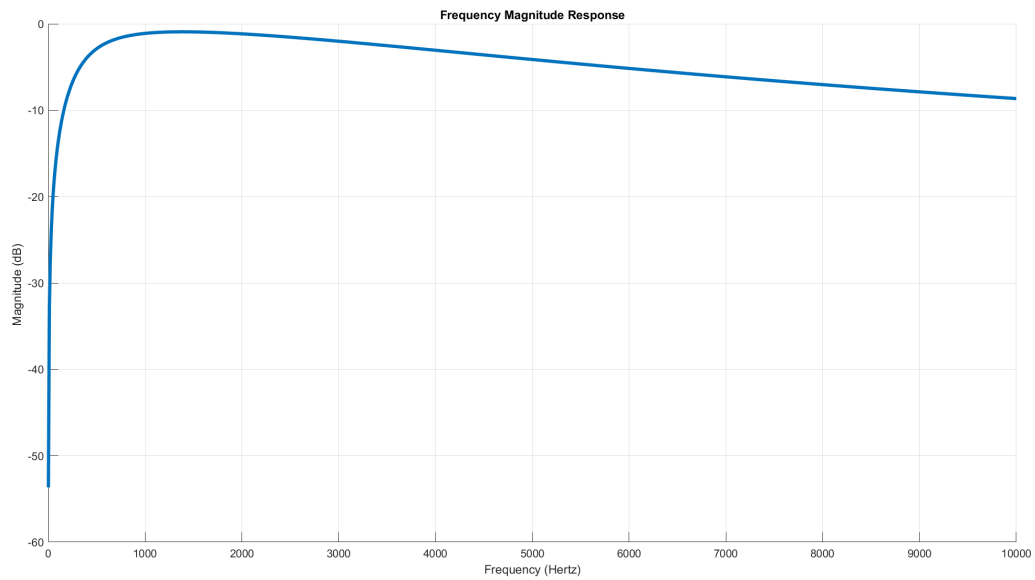As the switch closed the plot given in Figure 9 is obtained.

Figure 9: Frequency Response of a Band Pass Filter

6.3 c.

The circuit given in Figure 3 is simulated in LTSpice simulation environment as given in Figure 10. The capacitor value is fixed as $0.1\mu F$
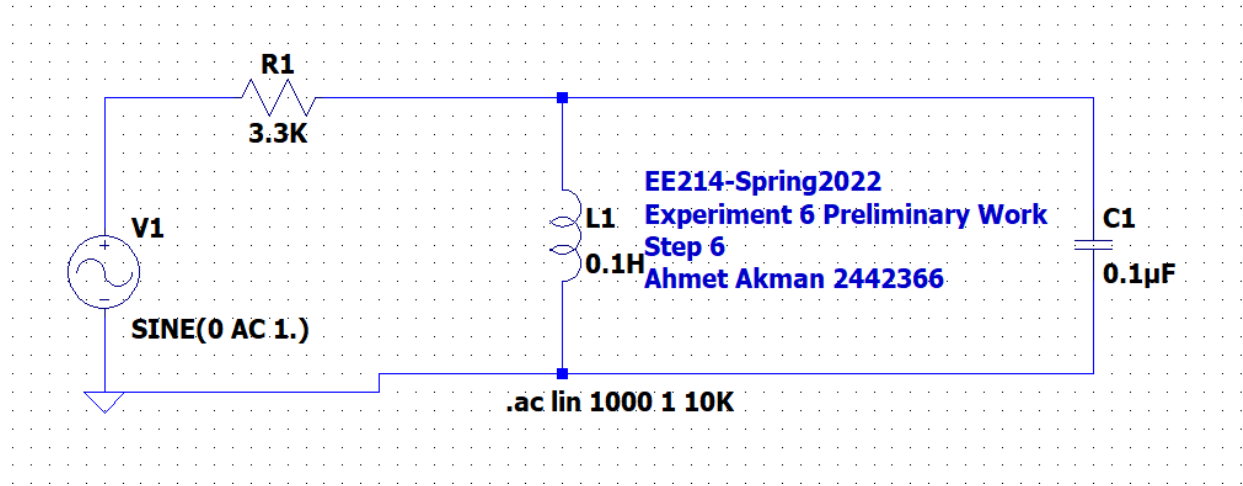

Figure 10: Simulation circuit schematic for the step 6 part c

6.3.1 i.

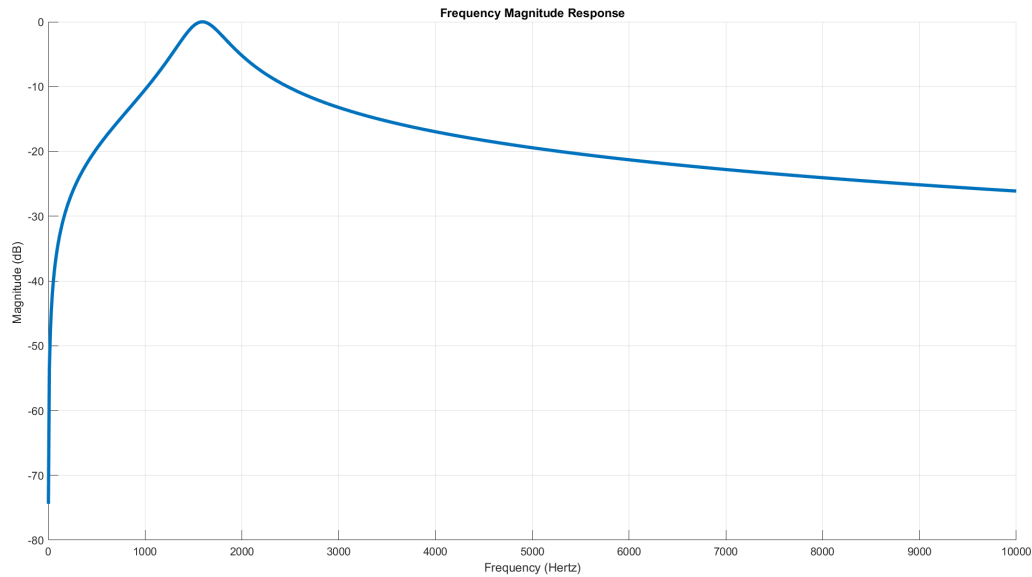As the resistor value set to 3.3K the plot given in Figure 11 is obtained.

Figure 11: Frequency Response of a Band Pass Filter

6.3.2 ii.

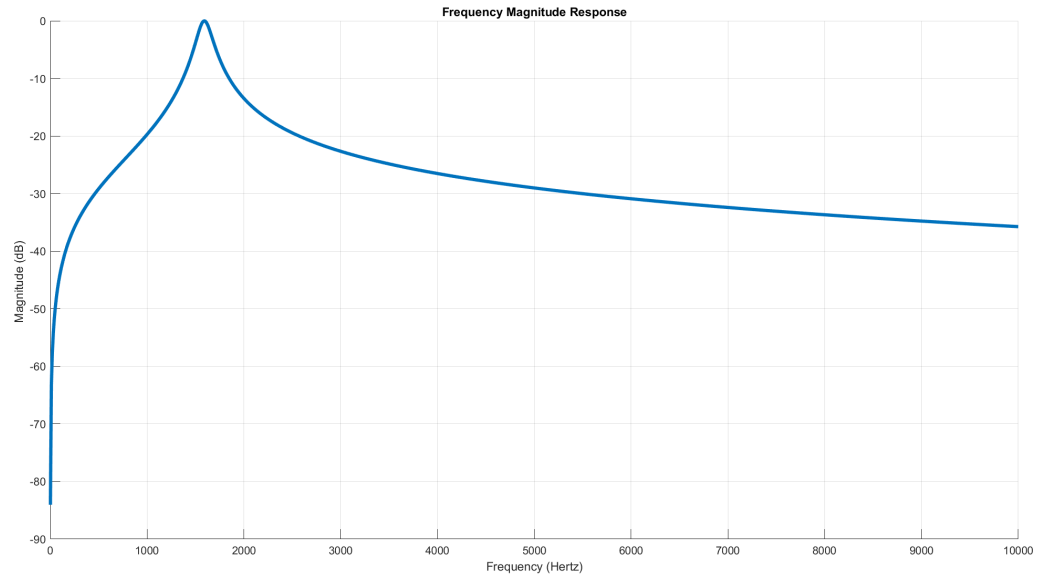As the resistor value set to 10K the plot given in Figure 12 is obtained.

Figure 12: Frequency Response of a Band Pass Filter

6.3.3 iii.

Similarly for the square wave input with the response of our bandpass filter is obtained as given in Figure 13.
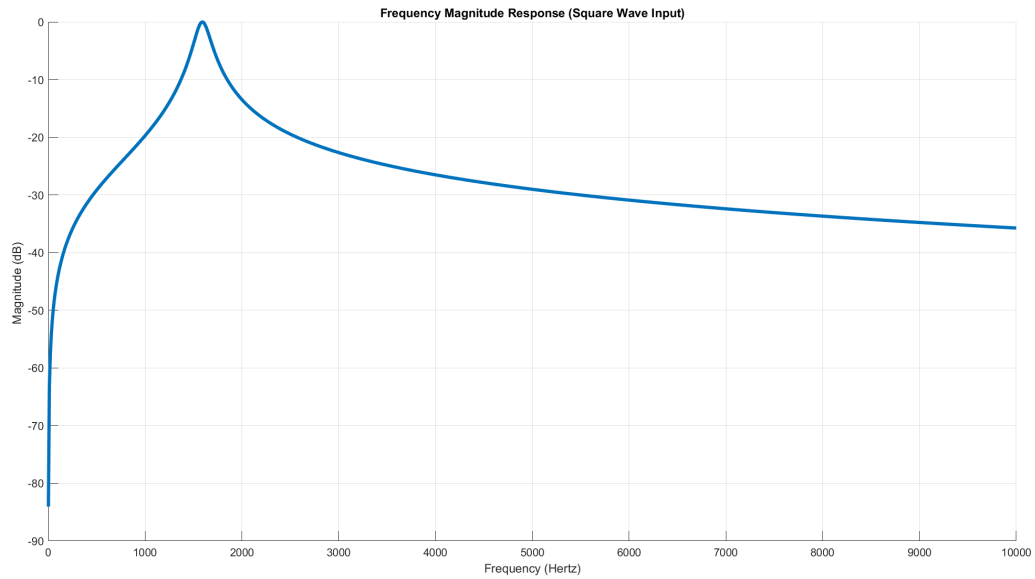
Figure 13: Frequency Response of a Band Pass Filter (square wave input)

7   Conclusion

In this preliminary document the characteristics of the filter topologies are investigated.

Appendix A

The results of the some of the simulations are fetched from LTSpice and plotted in MATLAB in order to make the plots more readable and convenient.